# Model Based Enterprise – An Industry Collaboration

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February 26, 2008

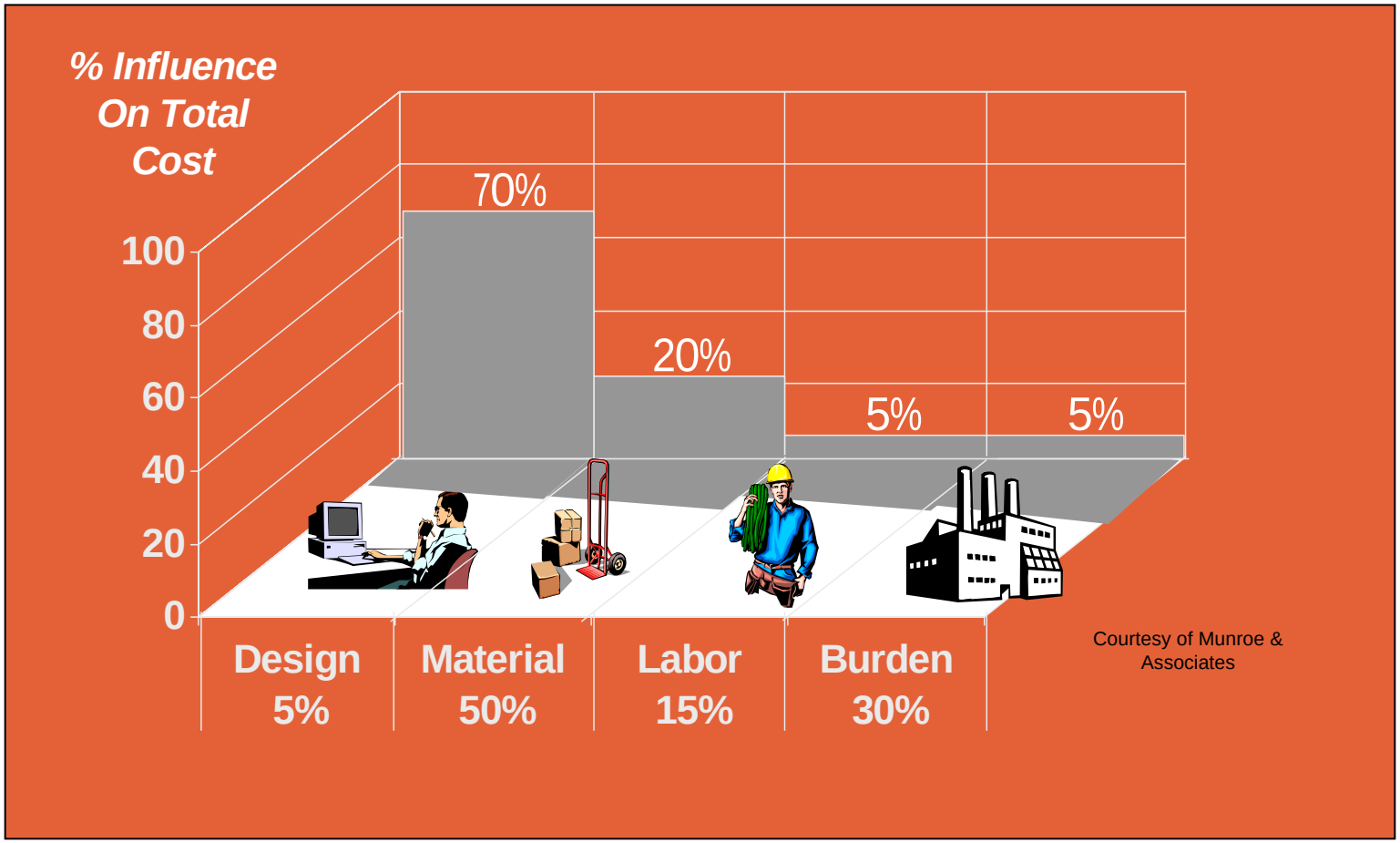
Rockwell Collins

# Business expectations continue to grow

- Customers want higher performance at lower cost
- Shareholders look for greater returns
- Companies desire organic growth in current market segments with limited cost impact
- Growth by acquisition must be dealt with cost effectively

***How can we optimize performance to meet all of the expectations?***

# Industry has known this for years.....



# U.S. Industry is working to implement a solution…. Integrated Life Cycle Decision Making, aka the Model Based Enterprise

- In 2004, an Industry team comprised of Boeing, Lockheed Martin, Raytheon Missile Systems, Rockwell Collins and Sandia National Labs launched an effort to evaluate collaboration in this area

- This initial team has now morphed into a combined effort of the U.S. NGMTI and PDES Inc. MBE teams

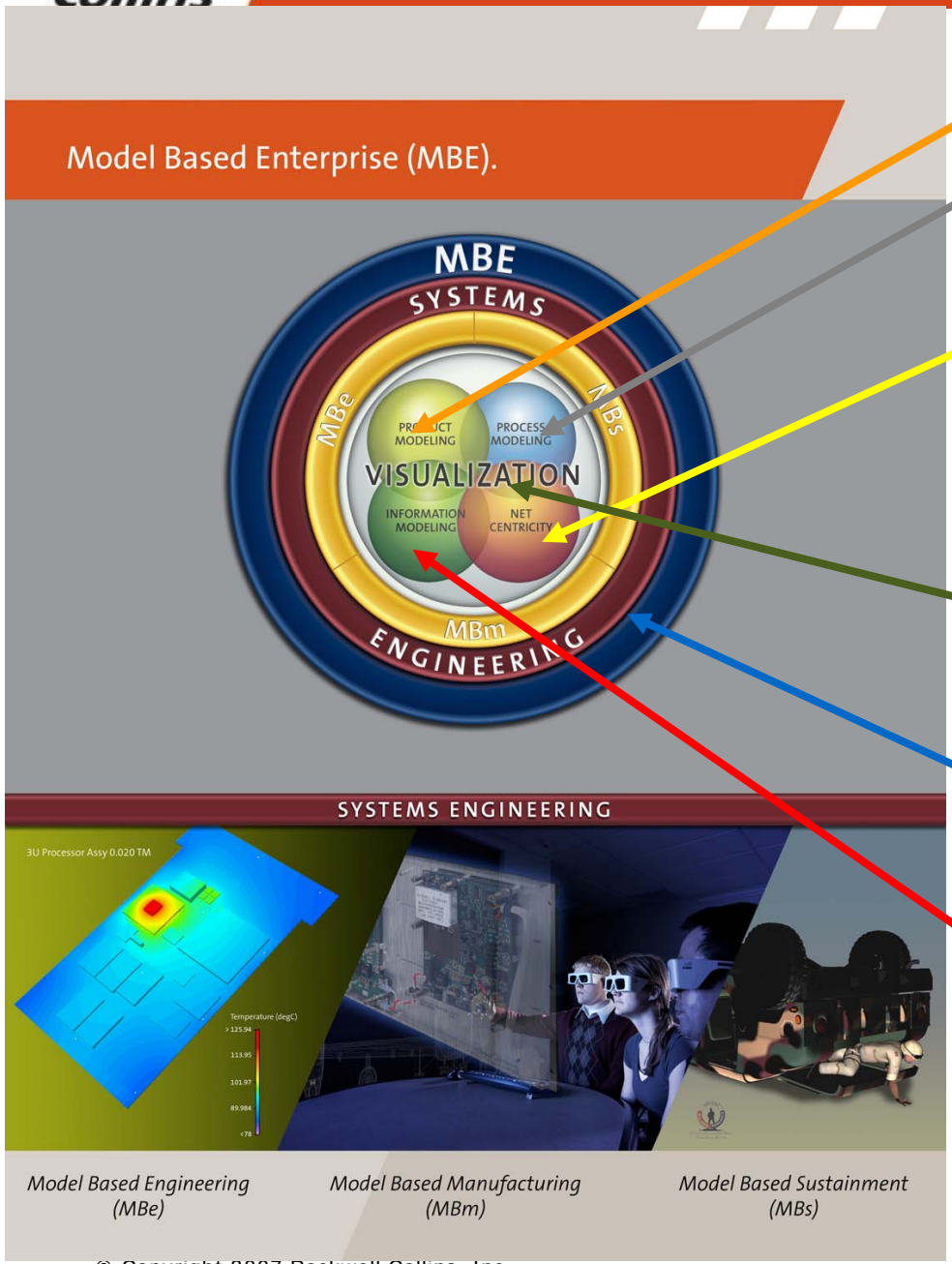
- The team briefed at the Defense Manufacturing Conference in December 07 and at the Marcus Evans Defense Manufacturing Summit in February 08

# Industry needs to .....

- Optimize designs for all life cycle requirements
- Produce all information automatically to execute enterprise processes
- Manufacture products in a virtual environment to predict and solve problems before they occur on the floor
- Design for the best total value
- Predict overall performance to reduce schedule slips and cost overruns

**Development in the virtual world,**
**leads to effective deployment in the real world**

# What is the MBE?




Product modeling assesses end item performance against life cycle requirements

Process modeling assesses process related performance against life cycle requirements

Whether MBe, MBm or Mbs, Net Centricity ensures the availability of managed information at the right place and time, supporting multi functional decision making and execution across the extended enterprise

Improved effectiveness of the MBE is achieved through state of the art visualization

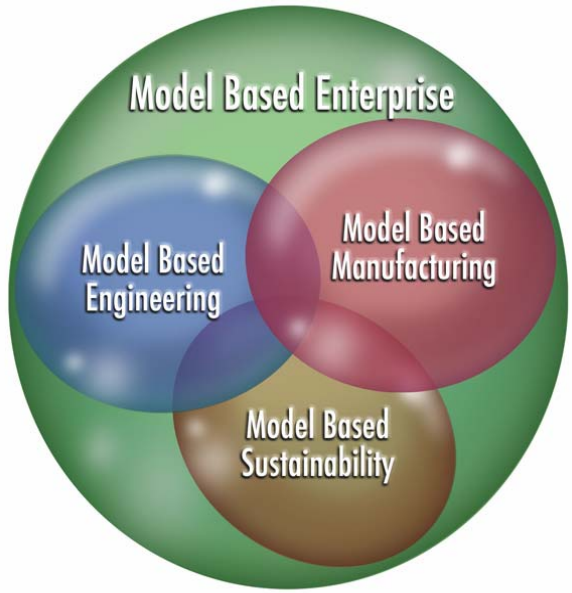
The wrapper around MBe, MBm and Mbs is Systems Engineering which manages and provides traceability of requirements throughout the life cycle

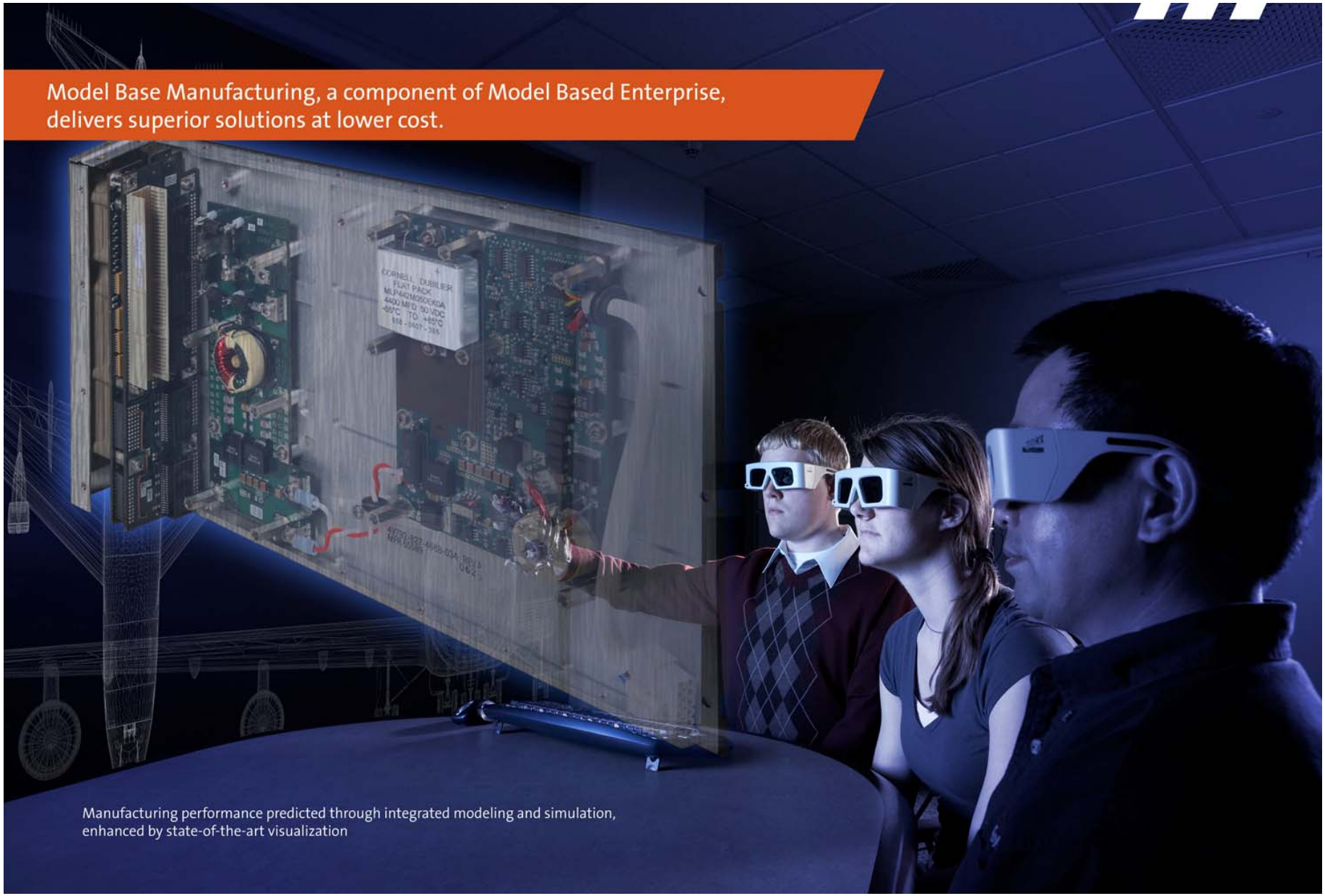
Information modeling incorporates standard formats to ensure interoperability of like and cross domain decision making tools and processes

# Industry has defined the MBE as……

***An integrated environment that enables multi-disciplinary decision making addressing the entire life cycle***

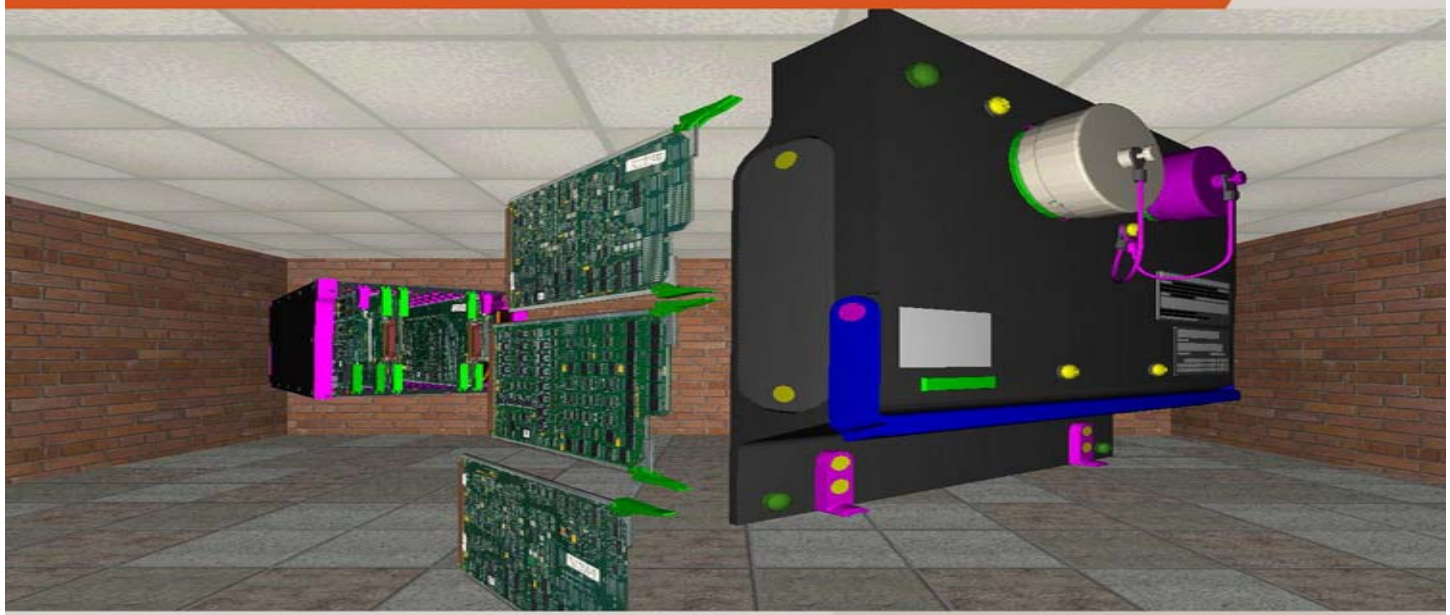
- Models are defined as information abstractions from enterprise data for application in domain specific use
- Tools and processes are integrated through the application of standard information
- Information is accessible through PLM interfaces
- Key Life Cycle Characteristics predicted through math and science based simulation





MODEL BASED MANUFACTURING

## Enhances performance through integrated simulation and visualization environments.



### Product Modeling
- Optimize design implementation
- Reduce prototype investment
- Improve manufacturing yield

### Process Modeling
- Improve process efficiency
- Reduce manufacturing variation
- Enhance inventory management

### Information Modeling
- Interoperability of like domain tools
- Interoperability of cross domain tools
- Reduce life cycle costs

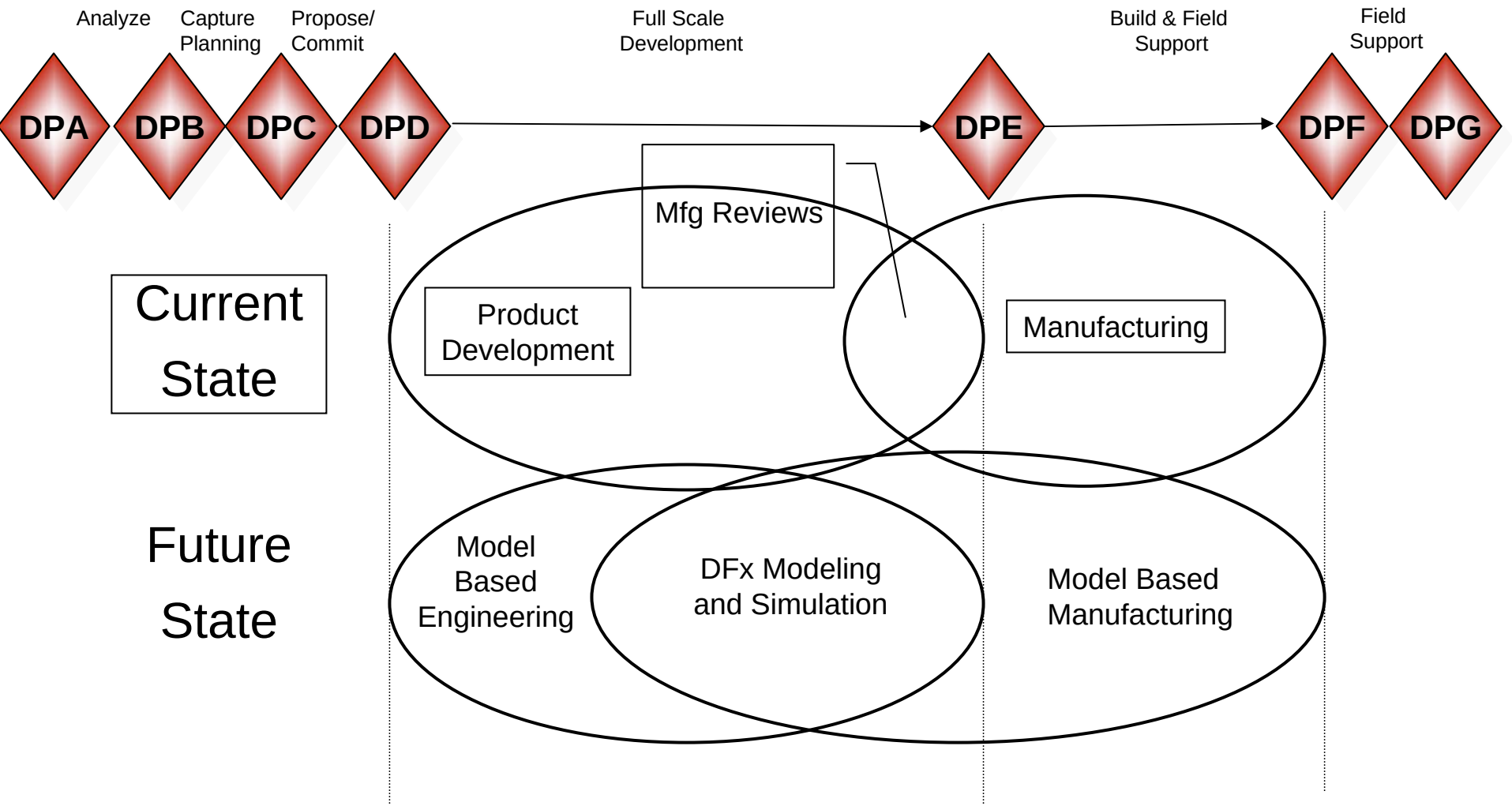
### Net Centric Manufacturing
- Improve supply chain management
- Increase effectiveness of manufacturing execution within the enterprise
- Enhance customer communication

## The good news……

- Domain specific tools have significant functionality
- Enterprise business tools have gained robustness

## OK, so……

- Gaps in modeling and simulation tools exists
- Interoperability is a obstacle
- Process management a necessity




Without process rigor, the best of breed/integrated tools won't provide the desired outcome

# MBE Active Projects and Project Opportunities

MBe – Model Based Engineering
MBm – Model Based Manufacturing
MBs – Model Based Sustainment

**Active Project: Systems Engineering (AP233)**

Participants:
- NIST
- Eurostep
- NASA
- ATI

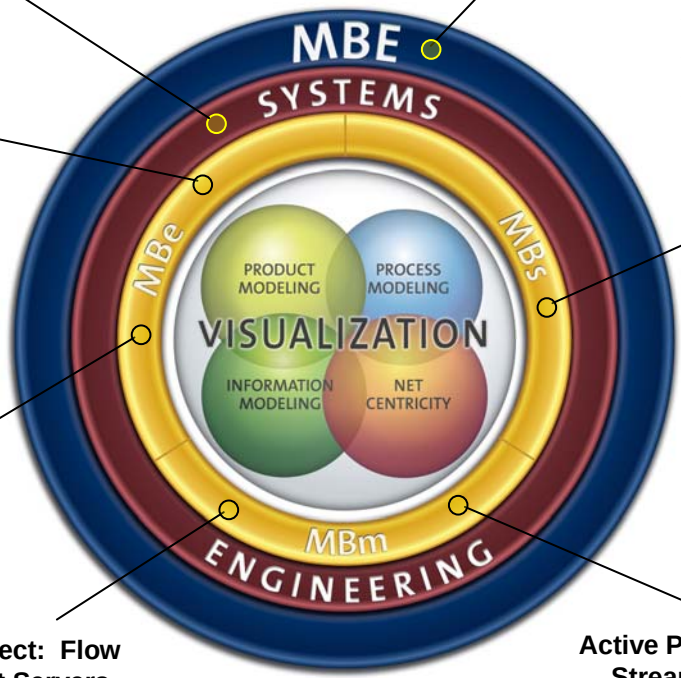
**Active Project: MBE-IF Testing**

Like Domain Participants:
- PTC
- Theorem Solutions
- LKSoft
- MSC
- Georgia Tech
- DataKit
- SFM Technology

Cross Domain Participants:
- PTC
- Theorem Solutions
- CostVision
- EuroSTEP

**Active Project: Engineering Analysis - STEP Composites and CAE Visualization in Adobe Acrobat**

Participants:
- Adobe Systems
- Lockheed Martin Aeronautics
- Boeing




**Active Project: System Life Cycle Support**

Participants:
- US Army
- Eurostep
- PTC
- NIST

**Potential MBe Project:**
**ECAD/MCAD Integration**

**Potential MBs Project:**
**Long Term Data Retention**

**Active Project: EM Pilot – Warpage Simulation**

Participants:
- Georgia Tech
- InterCAX
- LKSoft
- Rockwell Collins
- NIST

**Active Project: Flow Equivalent Servers**

Participants:
- Georgia Tech
- Boeing
- Raytheon Missile Systems
- Lockheed Martin
- Rockwell Collins
- NIST

**Potential MBm Projects:**
**Next Generation Supply Chain Modeling**
**Integrated Flow Modeling and Physical Layout**
**Design For Ergonomics**
**Cognitive Virtual Environment**

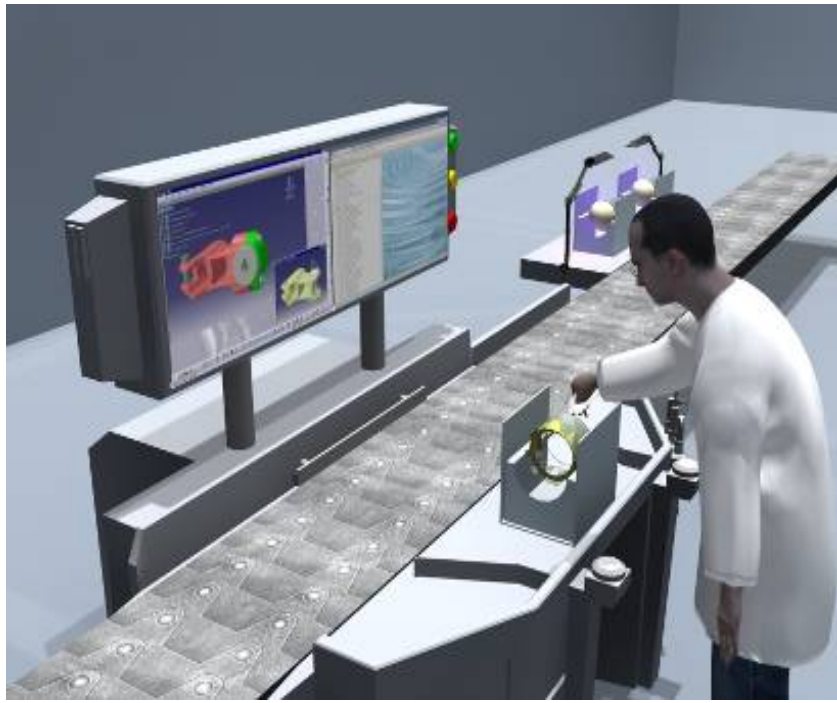
**Active Project: Value Stream Mapping**

Participants:
- Georgia Tech
- Boeing
- Raytheon Missile Systems
- Lockheed Martin
- Rockwell Collins
- NIST

***PDES, Inc.***

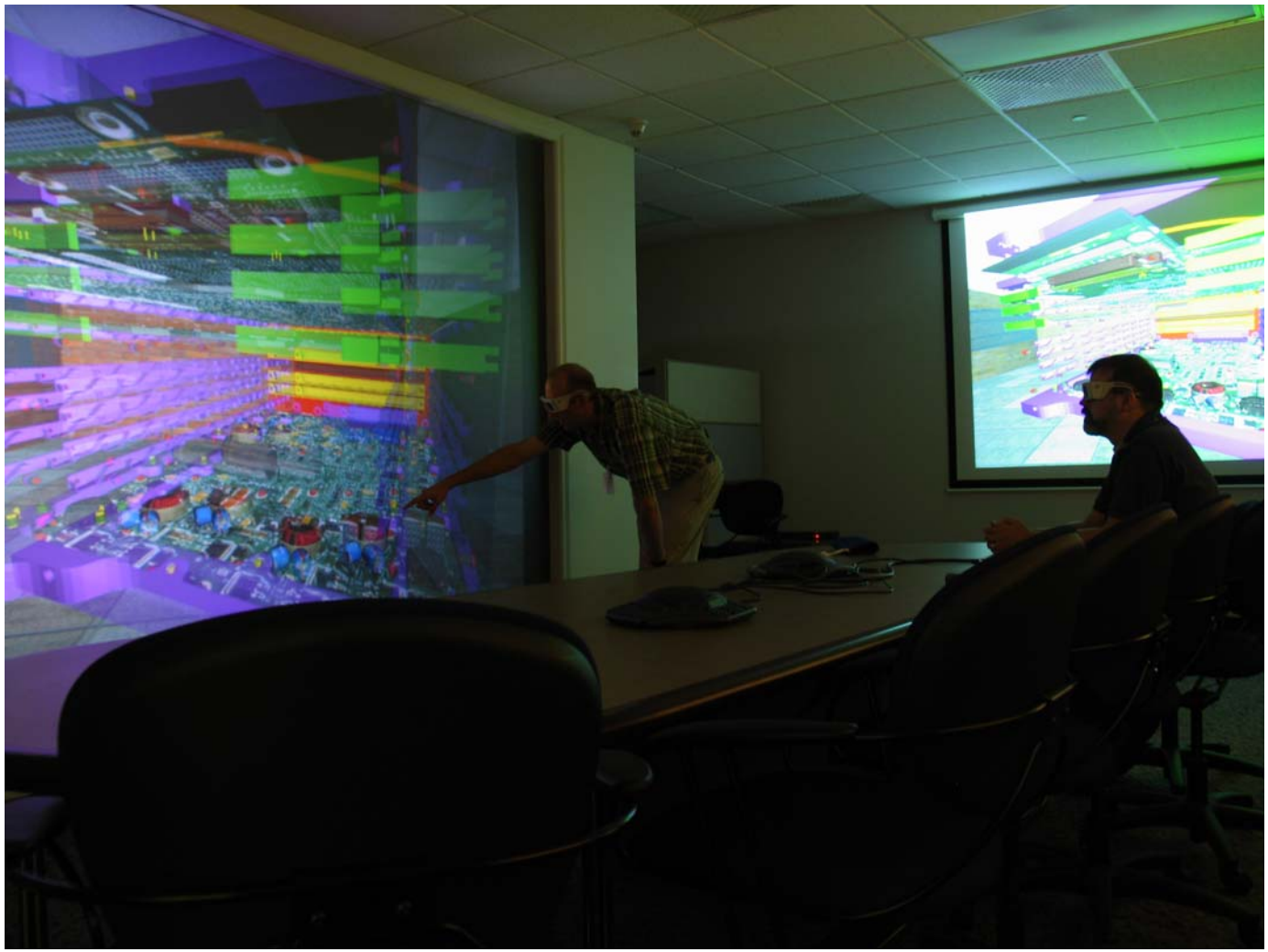
# Model Based Manufacturing Objectives

- Implement 3D modeling and simulation
  - Feedback on producibility and product simplification during design
  - Replace ***build–test–redesign*** paradigm with ***model–test–build*** paradigm
  - Lower initial product costs by maturing designs through modeling
- Early and accurate cost estimation
  - Verified cost models for negotiations and trade studies
- Integrate human factors and ergonomic analysis
- Connect design efforts to the manufacturing capability
- Close the loop with shop floor control



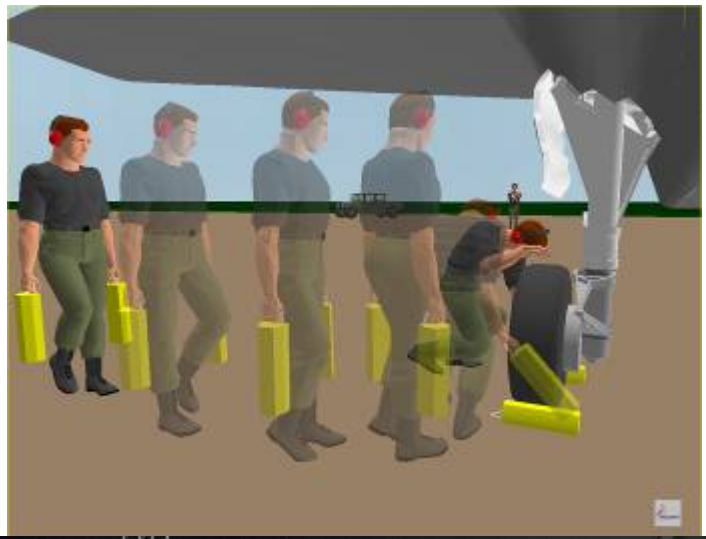
**Model Based Manufacturing completes the collaborative design environment between Operations, Engineering, and Supply Chain**

# State of Art Visualization improves a team's decision making ability

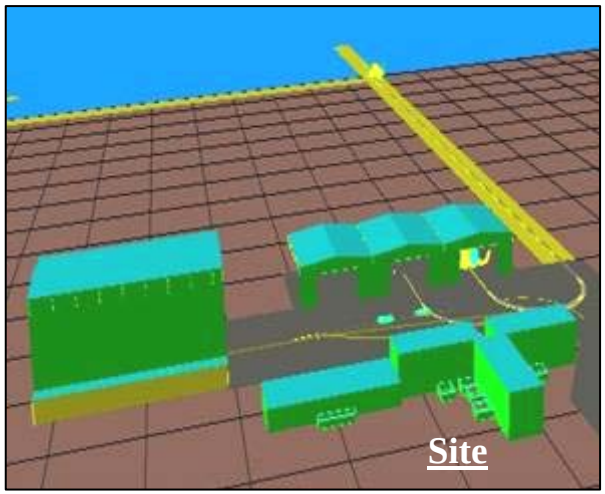


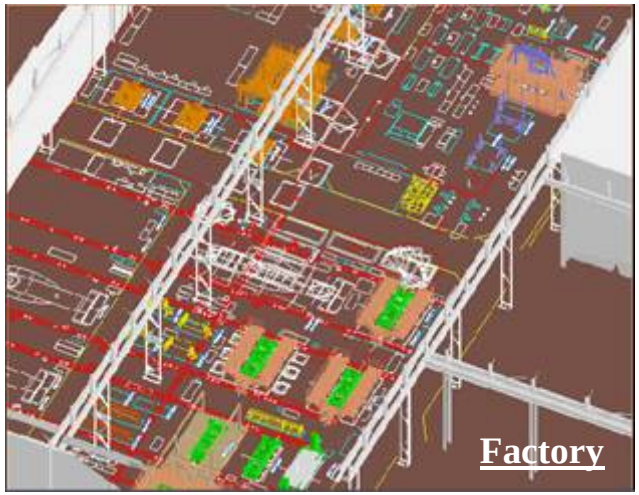
# Cost Effective Maintainability Analysis

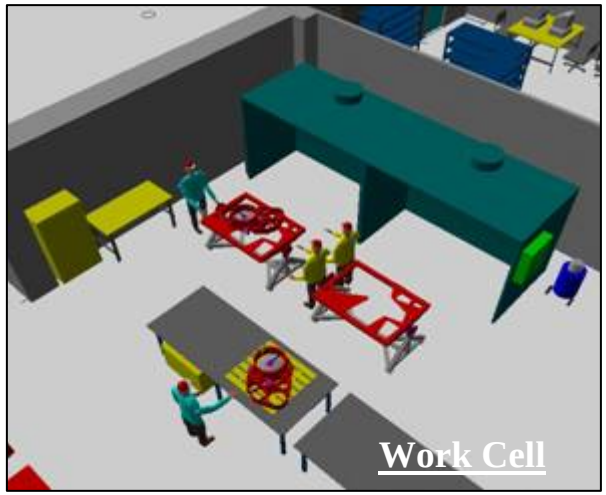
- Real time motion capture posturing (over 70% Reduction in Engineering labor per Ergo study)
- Allows for high resolution look at problem areas
- Reduce labor time to build simulation and to complete analysis
- Availability to a full-scale Immersion System (CAVE/HMD)



# Discrete Event Simulation




*Tooling & Resource Utilization / Labor Requirements*

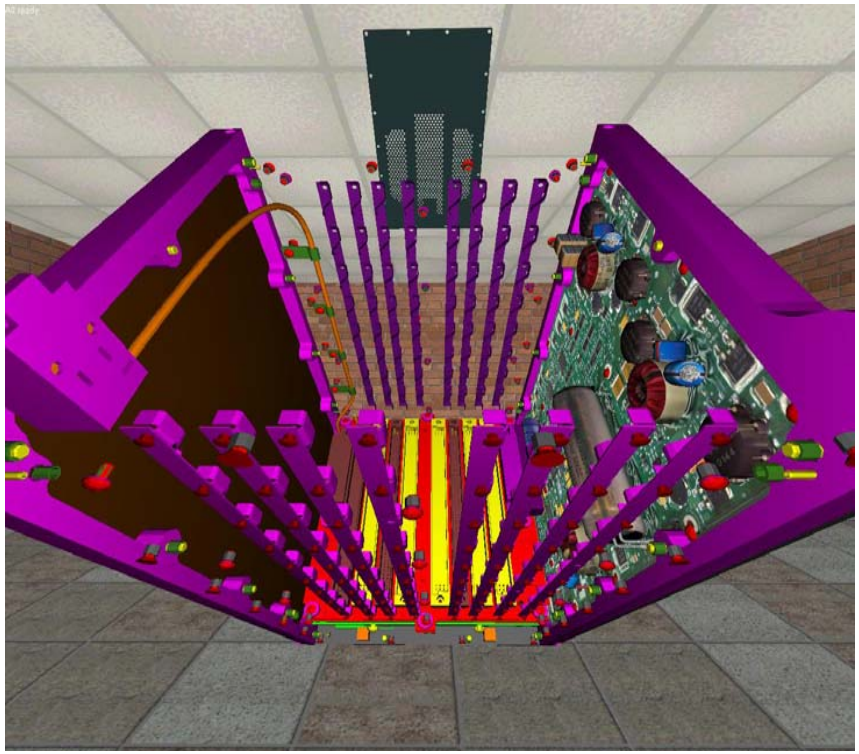
***Programs:***

- **Boeing Commercial Airplanes (BCA)**
  - 737 / 747 / 777
- **Aircraft & Missiles (A&M)**
  - F/A-18E/F / Chinook
  - F/A-18EFF / DD-21 / V-22
- **Space & Communication (S&C)**
  - Space Shuttle / NMD / SLI / LMARS

***Benefits:***

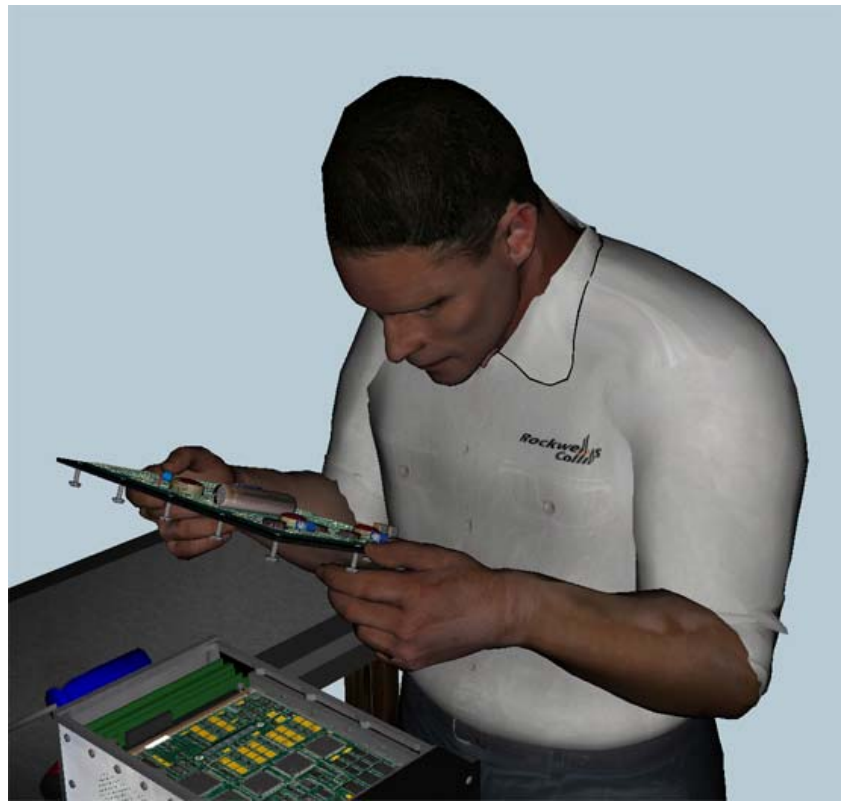
- Validates labor requirements
- Provides tooling and resource utilization requirements
- Assesses capacity, cycle time, throughput
- Evaluates alternative process scenarios
- Enables optimization of process flow

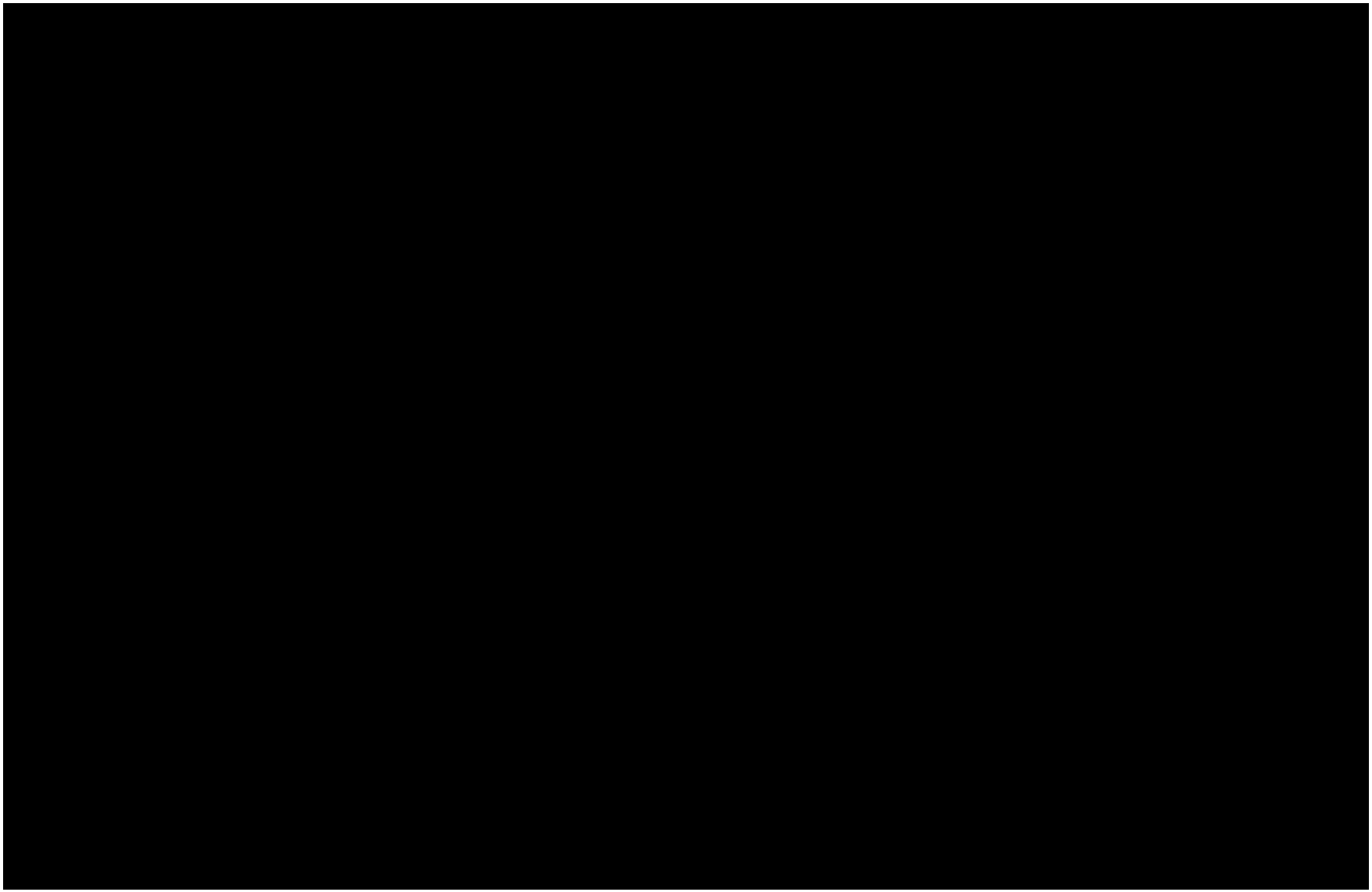
# *Example of collaborative project in Model Based Manufacturing*



***Standard Information being used to support lightweight visualization***

***Next Generation Human Model being evaluated to support Ergonomic design***





# Summary

- Improvements in business performance are tied to the effective use of the MBE
- Interoperability of enterprise tools is an industry problem which hampers performance
- Collaborative frameworks help industry address the needs of the MBE in a pre-competitive environment
- Significant industrial commitment and collaboration is making a difference

**Do the IMS partners have interest in being involved in MBE development?**